

3.3 CLASSIFICATION OF REQUIREMENTS

a. Applicability

The requirements set forth in this section describe procedures, specifications, and other technical requirements for grain weighing equipment and related grain handling systems used in performing Class X or Class Y weighing services and inspection services under the Act.

b. General Requirements

(1) Identification

All equipment, except weights, shall be clearly and permanently marked for the purposes of identification with the following information:

- (a) The name, initials, or trademark of the manufacturer or distributor;
- (b) A model designation that positively identifies the pattern or design of the device;
- (c) Except for equipment with no moving or electronic component parts, a nonrepetitive serial number; and
- (d) The serial number shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required serial number (H-44, 1994, G-S.1.).

(2) Official Testing and Certification

All official testing shall be performed according to the instructions. Official certification and application of an "Approved Label for Inspected Machinery" (Approval Seal) shall be made only by FGIS, authorized delegated or designated State, or approved scale testing organization.

(3) Facilitation of Fraud

All equipment and all mechanisms and devices attached thereto, or used in connection therewith, shall be so constructed, assembled, and installed for use that they do not facilitate the perpetration of fraud. (H-44, 1994, G-S.2.)

(4) Permanence

All equipment shall be of such materials, design, and construction as to make it probable that, under normal service conditions:

- (a) Accuracy will be maintained,
- (b) Operating parts will continue to function as intended, and
- (c) Adjustments will remain reasonably permanent. Undue stresses, deflections, or distortions of parts shall not occur to the extent that accuracy or permanence is detrimentally affected. (H-44, 1994, G-S.3.)

(5) Abnormal Performance

Unstable indications or other abnormal equipment performance observed during operation shall be brought to the attention of the equipment's owner or owner's representative. If immediate correction cannot be made, the scale shall be taken out of service until corrective action is taken and the accuracy of the scale recertified. (H-44, 1994, G-UR.4.2. in part)

(6) Use of Adjustments

Weighing elements and measuring elements that are adjustable shall be adjusted only to correct those conditions that such elements are designed to control and shall not be adjusted to compensate for defective or abnormal installation or accessories or for badly worn or otherwise defective parts of the assembly. Any faulty installation conditions shall be corrected, and any defective parts shall be renewed or suitably repaired, before adjustments are undertaken. Whenever equipment is adjusted, the adjustments shall be so made as to bring performance errors as close as practicable to zero value. (H-44, 1994, G-UR.4.3.)

(7) Suitability of Equipment

Official grain weighing equipment shall be suitable for the application for which

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

it is to be used, and shall conform to the requirements of these regulations as being correct with respect to elements of its design, including but not limited to its weighing capacity, its computing capability, the character, number, size, and location of its indicating or recording elements, and the value of its smallest division. (H-44, 1994, G-UR.1.1. in part)

(8) Environment

Equipment shall be suitable for the environment in which it is used including, but not limited to, the effects of wind, weather and radio frequency interference (RFI). (H-44, 1994, G-UR.1.2.)

(9) Interchange or Reversal of Parts

Parts of a device that may readily be interchanged or reversed in the course of field assembly or of normal usage shall be:

- (a) So constructed that their interchange or reversal will not affect the performance of the device, or
- (b) So marked as to show their proper positions.

(H-44, 1994, G-S.4.)

(10) Installation

A device shall be installed in accordance with the manufacturer's instructions, including any instructions marked on the device. A device installed in a fixed location shall be so installed that neither its operation nor its performance will be adversely affected by any characteristic of the foundation, supports, or any other detail of the installation. (H-44, 1994, G-UR.2.1.)

(11) Installation of Indicating and Recording Elements

A device shall be installed so that there is no obstruction between a primary indicating and recording element and the load receiving element; otherwise there shall be convenient and permanently installed means for direct communication, oral or visual, between an individual located at a primary indicating or recording

element and an individual located at the load-receiving element. Radios are considered direct communication and are acceptable providing they are at all times available for use. (H-44, 1994, G-UR.2.2. in part)

(12) Method of Operation

Equipment shall be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment. Manufacturers are required to supply complete detailed operating instructions with the equipment and to FGIS. (H-44, 1994, G-UR.3.1. in part)

(13) Associated and Nonassociated Equipment

A device shall meet all performance requirements when associated or nonassociated equipment is operated in its usual and customary manner and location. (H-44, 1994, G-UR.3.2.; G-N.2.)

(14) Maintenance of Equipment

All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service. Equipment in service at a single place of business found to be in error predominately in a direction favorable to the device user shall not be considered "maintained in a proper operating condition." (H-44, 1994, G-UR.4.1.)

c. Design of Indicating and Recording Elements and of Recorded Representations

(1) General

All weighing devices shall be provided with indicating or recording elements appropriate in design and adequate in amount. Primary indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device. (H-44, 1994, G-S.5.1.)

(2) Weight-Recording Device

Each grain scale, except portable platform scales, shall be equipped with a weight-recording device.

(3) Permanence

Graduations, indications, or recorded representations and their defining figures, words, and symbols shall be of such character that they will not tend easily to

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

become obliterated or illegible. (H-44, 1994, G-S.5.2.5.)

(4) Provisions for Sealing

- (a) Except on Class I scales, provision shall be made for applying a security seal in a manner that requires the security seal to be broken before an adjustment can be made to any component affecting the performance of an electronic device.
- (b) Except on Class I scales, a device shall be designed with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that affects the metrological integrity of the device can be made to any electronic mechanism. (H-44 1994, S.1.11.; G-S.8., and S.1.6. ABWS in part)
- (c) Except on Class I scales, audit trails shall use the format set forth in the following table. (H-44 1994, S.1.11.; G-S.8., and S.1.6. ABWS in part)

<i>Categories of Device and Methods of Sealing</i>	
Categories of Device	Method of Sealing
Category 1: No remote configuration capability	Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability, but access is controlled by physical hardware Device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode.	The hardware enabling access for remote communication must be at the device and sealed using a physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 3: Remote configuration capability access may be unlimited or controlled through a software with (e.g., password)	An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but no more than 1000 records are required. <i>(Note: Does not require 1000 changes to be stored for each parameter.)</i>

[Nonretroactive and enforceable as of January 1, 1995]

(5) Digital Indication and Representation

Digital elements shall be so designed that:

- (a) All digital values of like value in a system agree with one another.
- (b) A digital value coincides with its associated analog value to the nearest minimum graduation,
- (c) A digital value "rounds off" to the nearest minimum unit that can be indicated or recorded.
- (d) A digital zero indication includes the display of a zero for all places that are displayed to the right of the decimal point and at least one place to the left. When no decimal values are displayed, a zero shall be displayed for each place of the displayed scale division. (H-44, 1994, G-S.5.2.2.)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

(6) Recording Sequence

Provision shall be made so that all weight values are indicated until the completion of the recording of the indicated value. (H-44, 1994, S.1.5. ABWS Code)

(7) Recorded Weight Identification

Gross weight, tare weight, net weight, subtotal, and total printed representations shall either be identified by a symbol clearly and accurately identifying the type weight printed, (e.g., G-Gross, T-Tare, N-Net, ST-Subtotal, TO-Total) or shall be identified as such on the ticket or tape on which they are printed.

(8) Change in Mode of Operation

All grain weighing automatic hopper scales shall be designed so that the mode of operation and each change in mode of operation is indicated on the printed record by a symbol, number, or word which clearly designates the mode in which the scale is operated; i.e., A-automatic, M-manual, SA-semiautomatic; 1-automatic, 2-manual, 3-semiautomatic.

(9) Capacity Indication

An indicating or recording element shall not display nor record any values when the gross load or platform (not counting the initial dead load that has been canceled by an initial zero-setting device) is:

- (a) In excess of 105% of scale capacity. (H-44, 1994, S.1.7., ABWS Code, S.1.3. in part)
- (b) The recording element shall not record gross loads in excess of 105 percent of capacity unless the recorded representation clearly

indicates that the system is in an overload condition; i.e., "overload."

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation.

This requirement does not apply to: (1) single-revolution dial scales, (2) multi revolution dial scales not equipped with unit weights, (3) scales equipped with two or more weighbeams, nor (4) devices that indicate mathematically-derived totalized values.

(10) Size and Character

In any series of graduations, indications, or recorded representations, corresponding graduations and units shall be uniform in size and character. Graduations, indications, or recorded representations which are subordinate to or of a lesser value than others with which they are associated shall be appropriately portrayed or designated. (H-44, 1994, G-S.5.2.3.)

(11) Values

If graduations, indications, or recorded representations are intended to have specific values, these shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof, uniformly placed with reference to the graduations, indications, or recorded representations and as close thereto as practicable, but not so positioned as to interfere with the accuracy of reading. (H-44, 1994, G-S.5.2.4.)

(12) Dual Indications

On equipment designed to indicate or record in more than one unit of measurement, the values indicated or recorded shall be identified with an appropriate word, symbol, or abbreviation. (H-44, 1994, G-S.5.3.1. in part)

(13) Weight Entries to Recording Devices

The displayed weight on electronic or levertronic scales shall be entered into automatic recording devices only electronically and directly from the related weighing instrument.

(14) Size of Graduated Intervals or Increments

In any series of graduations, indications, or recorded representations, the values of the graduated intervals or increments shall be uniform throughout the series. (H-44, 1994, G-S.5.3.)

(15) Repeatability of Indications

A device shall be capable of repeating within prescribed tolerances its indications and recorded representations. This requirement shall be met

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

irrespective of repeated manipulation of any element of the device in a manner approximating normal usage (including displacement of the indicating elements to the full extent allowed by the construction of the device and repeated operation of a locking or relieving mechanism) and of the repeated performance of steps or operations that are embraced in the testing procedure. (H-44, 1994, G-S.5.4.)

(16) Recorded Representations

Insofar as they are appropriate, the requirements for indicating and recording elements shall be applicable also to recorded representations. All recorded values shall be printed digitally. (H-44, 1994, G-S.5.6.)

(17) Tape Printers

Tape printers on automatic-indicating scales shall be designed to produce a minimum of an original and one copy of the printed record.

(18) Ticket Printers

Ticket printers on automatic-indicating scales shall be designed to produce an original and five copies of the printed record. Ticket printers on nonautomatic-indicating scales shall be designed to produce an original and one copy of the printed record.

(19) Multiple Indications and Recorded Representations

All indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device and shall agree with primary indications.

(20) Marking Operational Controls, Indications, and Features

All operational controls, indications, and features, including switches, lights, displays, pushbuttons, and other means shall be clearly and definitely identified. (H-44, 1994, G-S.6.)

(21) Gate Position

Provisions shall be made to clearly indicate to the operator the position of the gates leading directly to and from the weigh hopper. (H-44, 1994, S.3.1. ABWS Code)

(22) Interlocks

Each automatic bulk weighing system shall have operating interlocks to provide for the following:

- (a) Product cannot be cycled and weighed if the weight recording element is disconnected or subjected to a power loss,
- (b) The recording element cannot print a weight if either of the gates leading directly to or from the weigh hopper is open,
- (c) A "low paper" sensor, when provided, is activated, and
- (d) The system will operate only in the proper sequence in all modes of operation.
- (e) When an overfill alarm is activated, the system shall indicate and record an overfill condition. (H-44, 1994, S.3.2. ABWS Code)

(23) Overfill Sensor

The weigh hopper shall be equipped with an overfill sensor which will cause the feed gate to close, activate an alarm, and inhibit weighing until the overfill condition has been corrected. (H-44, 1994, S.3.3. ABWS Code)

(24) Weighing Sequence

- (a) For automatic bulk weighing systems used to receive (weigh in), the no-load reference value shall be determined and recorded only at the beginning of each weighing cycle. For automatic bulk weighing systems used to deliver (weigh out), the no-load reference value shall be determined and recorded only after the gross load reference value for each weighing cycle has been indicated and recorded. (H-44, 1994, S.1.4. ABWS Code)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

- (b) On a single draft manually operated receiving hopper scale installed below grade, used to receive grain, and utilizing a no-load reference value, provision shall be made to indicate and record the no-load reference value prior to the gross load value. (H-44, 1994, S.1.1.2.)

(25) Zero Indication for Automatic Bulk Weighing and Other Systems

Provisions shall be made to indicate and record a no-load reference value and if the no-load reference value is a zero indication, to indicate and record an out-of-balance condition on both sides of zero. (H-44, 1994, S.1.1., ABWS Code in part)

(26) Zero Indication - Digital Indicating Elements

- (a) A digital zero indication shall represent a balance condition that is within $\pm \frac{1}{2}$ the value of the scale division.
- (b) A digital indicating device shall either automatically maintain a “center-of-zero” condition to $\pm \frac{1}{4}$ scale division or less, or have an auxiliary or supplemental “center-of -zero” indicator that defines a zero-balance condition to $\pm \frac{1}{4}$ of a scale division or less. (H-44, 1994, S.1.1.1.)

[Nonretroactive as of January 1993]

(27) Length of Graduations

Graduations shall be so varied in length that they may be conveniently read. (H-44, 1994, S.1.3.1.)

(28) Width of Graduations

In any series of graduations, the width of a graduation shall in no case be greater than the width of the minimum clear interval between graduations and the width of main graduations shall be not more than 50 percent greater than the width of subordinate graduations. Graduations shall not be less than 0.008 inch

in width. (H-44, 1994, S.1.3.2.)

(29) Clear Space Between Graduations

The clear space between graduations shall be not less than 0.03 inch. If the graduations are not parallel, the measurement shall be made:

- (a) Along the line of relative movement between the graduations and the end of the indicator, or
- (b) If the indicator is continuous, at the point of widest separation of the graduations. (H-44, 1994, S.1.3.3.)

(30) Symmetry of Indicators

The index of an indicator shall be symmetrical with respect to the graduations with which it is associated and at least throughout that portion of its length that is associated with the graduations. (H-44, 1994, S.1.4.1.)

(31) Dial Indicator Length

The index of an indicator shall reach to the finest graduations with which it is used, unless the indicator and the graduations are in the same plane, in which case the distance between the end of the indicator and the ends of the graduations, measured along the line of the graduations, shall be not more than 0.04 inch. (H-44, 1994, S.1.4.2.)

(32) Dial Indicator Width

The width of the index of an indicator in relation to the series of graduations with which it is used shall be not greater than:

- (a) The width of the widest graduation, and
- (b) The width of the clear space between weight graduations.
- (c) When the index of an indicator extends along the entire length of a graduation, that portion of the index of the indicator that may be brought into coincidence with the graduation shall be of the same width throughout the length of the index that coincides with the graduation. (H-44, 1994, S.1.4.3.)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

(33) Dial Indicator Clearance

The clearance between the index of an indicator and the graduations shall in no case be more than 0.06 inch. (H-44, 1994, S.1.4.4.)

(34) Parallax

Parallax effects shall be reduced to the practicable minimum. (H-44, 1994, S.1.4.5.)

(35) Dial Weight Ranges and Unit Weights

The total value of weight ranges and of unit weights in effect or in place at any time shall automatically be accounted for on the reading face and on any recorded representation. (H-44, 1994, S.1.7.,in part)

d. Design of Balance, Tare, and Damping, and Arresting Mechanisms

(1) Zero-Load - General

The weighing system shall be equipped with manual or semiautomatic means by which the zero-load balance or no-load reference value indication may be adjusted. An automatic zero-setting mechanism is prohibited on hopper scales. (H-44, 1994, S.2.1. ABWS Code in part)

(2) Zero-Load Adjustment

- (a) A manual zero-load or no-load reference value setting mechanism shall be operable or accessible only by a tool outside of or entirely separate from this mechanism or enclosed in a cabinet.

- (b) A semiautomatic zero-load or no-load reference value setting mechanism (push-button zero) shall be operable only when:
- 1) For automatic bulk weighing systems
 - a) The indication is stable within ± 3 scale divisions, and
 - b) It cannot be operated during a weighing operation. (H-44, 1994, S.2.1.1., S.2.1.2 ABWS Code in part)
 - 2) For other scales
 - a) The indication is stable within ± 3 scale divisions for scales of more than 5,000 pound capacity in service prior to January 1, 1981, and all railway track and vehicle scales, and
 - b) Plus or minus 1 scale division for all other scales. (H-44, 1994, S.2.1.2. in part)
 - 3) Zero-Load Adjustment on Mechanical Scales

Any loose material used to adjust the zero-load balance on a mechanical scale shall be so enclosed that it cannot shift in position and alter the balance condition of the scale. A balance ball shall not itself be rotatable unless it is automatic in operation or is enclosed in a cabinet. (H-44, 1994, S.2.1.1., and S.2.1.2. in part)
 - 4) Scales Equipped with an Automatic Zero-setting Mechanism

Under normal operating conditions the maximum load that can be "rezeroed" when all at once either placed on or removed from the platform shall be:

 - a) For vehicle and railway track scales ± 3.0 scale divisions, and
 - b) For all other scales except automatic bulk weighing scales ± 1 scale division. (H-44, 1994, S.2.1.3. in part)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

5) Tare

On any scale, the value of the tare division shall be equal to the value of the scale division. The tare mechanism shall operate only in a backward direction (that is, in a direction of underregistration) with respect to the zero-load balance condition of the scale. On a device designed to automatically clear any tare value entered, means shall be provided to prevent the clearing of tare until a complete transaction has been indicated. (H-44, 1994, S.2.3. in part)

6) Balance Indicator

On a balance indicator consisting of two indicating edges, lines, or points, the ends of the indicators shall be sharply defined. When the scale is in balance, the ends shall be separated by not more than 0.04 inch. A mechanical grain-test scale shall be equipped with a balance indicator. If this consists of an indicator and a graduated scale that are not in the same plane, the clearance between the indicator and the graduations shall be not more than 0.04 inch. (H-44, 1994, S.2.2. and S.2.2.2. in part)

7) Damping Means

An automatic-indicating scale and a balance indicator shall be equipped with effective means to damp oscillations and to bring the indicating elements quickly to rest. (H-44, 1994, S.2.5.)

8) Motion Detection

Electronic indicating elements equipped with recording elements shall be equipped with effective means to permit the recording of weight values only when the indication is stable within:

- a) Plus or minus 3 scale divisions for scales of more than 5,000 pounds capacity and for all vehicle and railway track scales.
 - b) Plus or minus 1 scale division for all other scales.
 - c) The values recorded shall be within applicable tolerances. (H-44, 1994, S.2.5.1.)
- 9) Motion Detection for Automatic Bulk Weighing Systems
- Effective means shall be provided to permit the recording of weight values only when the indication is stable within ± 3 scale divisions for devices with 10,000 scale divisions, or ± 1 division for devices with less than 10,000 scale divisions. (H-44, 1994, S.2.2. ABWS Code in part)
- 10) Level-Indicating Means
- A portable scale shall be equipped with level-indicating means if its weighing performance is changed by an amount greater than the appropriate acceptance tolerance when it is moved from a level position and rebalanced in a position that is out of level in any upright direction by 5 percent (approximately 3 degrees). The level-indicating means shall be readable without removing any scale parts requiring a tool. (H-44, 1994, S.2.4. in part)

e. Design of Weighing Elements

(1) Antifriction Means

Frictional effects shall be reduced to a minimum by suitable antifriction elements. Opposing surfaces and points shall be properly shaped, finished, and hardened. A platform scale having a frame around the platform shall be equipped with means to prevent interference between platform and frame. (H-44, 1994, S.4.1.)

(2) Adjustable Components.

An adjustable component such as a nose-iron, pendulum, spring, or potentiometer shall be held securely in adjustment and except for the

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

level-adjusting and zero-load balance mechanisms shall not be adjustable from the outside of the scale. The position of a nose-iron on a scale of more than 2,000-lb capacity, as determined by the factory adjustment, shall be accurately, clearly, and permanently defined. (H-44, 1994, S.4.2.)

(3) Multiple Load-Receiving Elements

A system with a single indicating or recording element, or a combination indicating-recording element, that is coupled to two or more load-receiving elements with independent weighing systems, shall be provided with means to prohibit the activation of any load-receiving element (or elements) not in use, and shall be provided with automatic means to indicate clearly and definitely which load-receiving element (or elements) is in use. (H-44, 1994, S.4.3.)

(4) Accuracy Classes on Scales Manufactured After January 1, 1986

Scales are divided into accuracy classes and shall be designated as II, III, or III L. The accuracy class of scales is designated by the manufacturer and shall comply with parameters shown in the table in this section under "i. 5." (H-44, 1994, S.5.1., S.5.2. in part)

(5) Multi-Range Scales

On a variable division-value scale, the value of "e" shall be equal to the value of "d". (H-44, 1994, S.5.3.)

f. Design of Weighbeams and Poises

(1) Normal Balance Position

The normal balance position of the weighbeam of a beam scale shall be horizontal. (H-44, 1994, S.1.5.1.)

(2) Travel of Pans of Equal-Arm Scale

The travel between limiting stops of the pans of a nonautomatic-indicating

equal-arm scale not equipped with a balance indicator shall be not less than the minimum travel shown in Tables 1 and 2:

(H-44, 1994, S.3.1.)

Table 1 Minimum Travel of Pans of Nonautomatic Indicating Equal Arm Scale Without Balance Indicator

Nominal capacity (kilograms)	Minimum travel of pans (millimeters)
2 or less	9
2+ to 5 inclusive	13
5+ to 12, inclusive	19
Over 12	25

(3) Drainage

A load-receiving element intended to receive wet commodities shall be so constructed as to drain effectively. (H-44, 1994, S.3.2.)

(4) Travel

The weighbeam of a beam scale shall have equal travel above and below the horizontal. The total travel of the weighbeam of a beam scale in a trig loop or between other limiting stops near the weighbeam tip shall be not less than the minimum travel shown in table 1. When such limiting stops are not provided, the total travel at the weighbeam tip shall be not less than 8 percent of the distance from the weighbeam fulcrum to the weighbeam tip. (H-44, 1994, S.1.5.2.)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

Table 2 Minimum Travel of Weighbeam of Beam Scale Between Limiting Stops

Distance from weighbeam fulcrum to limiting stops (inches)	Minimum travel between limiting stops (inch)
12 or less	0.4
12+ to 20, inclusive	0.5
20+ to 40, inclusive	0.7
Over 40	0.9

(5) Subdivision

A subdivided weighbeam bar shall be subdivided by scale division graduations, notches, or a combination of both. Graduations on a particular bar shall be of uniform width and perpendicular to the top edge of the bar. Notches on a particular bar shall be uniform in shape and dimensions, and perpendicular to the face of the bar. When a combination of graduations and notches is employed, the graduations shall be positioned, in relation to the notches, to indicate notch values clearly and accurately. (H-44, 1994, S.1.5.3.)

(6) Readability

A subdivided weighbeam bar shall be so subdivided and marked, and a weighbeam poise shall be so constructed, that the weight corresponding to any normal poise position can easily and accurately be read directly from the beam, whether or not provision is made for the optional recording of representations of weight. (H-44, 1994, S.1.5.4.)

(7) Poise Stop

Except on a steelyard with no zero graduation, a shoulder or stop shall be provided on each weighbeam bar to prevent a poise from traveling and remaining back of the zero graduation. (H-44, 1994, S.1.5.6.)

(8) Poeses

No part of a poise shall be readily detachable. A locking screw shall be perpendicular to the longitudinal axis of the weighbeam and shall not be removable. Except on a steelyard with no zero graduation, a poise shall not be readily removable from a weighbeam. The knife edge of a hanging poise shall be hard and sharp and so constructed as to allow the poise to swing freely on the bearing surfaces in the weighbeam notches. (H-44, 1994, S.1.6.1.)

(9) Poise Adjusting Material

The adjusting material in a poise shall be securely enclosed and firmly fixed in position and if softer than brass, it shall not be in contact with the weighbeam. (H-44, 1994, S.1.6.2.)

(10) Poise Pawl

A poise, other than a hanging poise, on a notched weighbeam bar shall have a pawl that will seat the poise in a definite and correct position in any notch, wherever in the notch the pawl is placed, and hold it there firmly and without appreciable movement. The dimension of the tip of the pawl that is transverse to the longitudinal axis of the weighbeam shall be at least equal to the corresponding dimension of the notches. (H-44, 1994, S.1.6.3.)

(11) Reading Edge or Indicator

The reading edge or indicator of a poise shall be sharply defined, and a reading edge shall be parallel to the graduations on the weighbeam. (H-44, 1994, S.1.6.4.)

g. Marking Requirements [See also Section 3.3 b.(1), (9), c. (20)]

(1) Capacity and Value of the Scale Division for Automatic Bulk Weighing Scales

The capacity of the weighing system and the value of the scale division shall be clearly and conspicuously marked on the indicating element near the weight

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

value indications. (H-44, 1994, S.5.1. ABWS Code)

(2) Location Of Marking Information

Scales that are not permanently attached to an indicating element, and for which the load-receiving element is the only part of the weighing/load-receiving element visible after installation, may have the marking information required in 3.3 b. (1) and Table 3 (following) located in an area that is accessible only through the use of a tool; provided that the information is easily accessible (e.g., the information may appear on the junction box under an access plate). The identification information for these scales shall be located on the weighbridge (load-receiving element) near the point where the signal leaves the weighing element or beneath the nearest access cover. (H-44, 1994, S.6.2.)

(3) Scales, Main Elements, and Components of Scales or Weighing Systems

Scales, main elements of scales when not contained in a single enclosure for the entire scale, load cells for which Certificates of Conformance (CC) have been issued under the National Type Evaluation Program, and other equipment necessary to a weighing system, but having no metrological effect on the weighing system, shall be marked as specified in Table 3 and explained in the accompanying notes (Table 3 a).

(H-44, 1994, S.6.3.)

Table 3 Marking Requirements

Weighing Equipment To Be Marked With	Weighing, load-receiving, and indicating element in same housing	Indicating element not permanently attached to weighing and load-receiving element	Weighing and load-receiving element not permanently attached to indicating element	Load Cell with CC (11)	Other Equipment or Device (10)
Manufacturer's ID (1)	x	x	x	x	x
Model Designation (1)	x	x	x	x	x
Serial Number and Prefix (2)	x	x	x	x	x (16)
Accuracy Class (17)	x	x (8)	x (19)	x	
Nominal Capacity (3)	x	x	x		
Value of Scale Division(d) (3)	x	x			
Value of "e" (4)	x	x			
Temperature Limits (5)	x	x	x	x	
Concentrated Load Capacity (12)		x	x (9)		
Special Application (13)	x	x	x		
Maximum Number of Scale Divisions (n_{max}) (6)		x (8)	x (19)	x	
Minimum Verification Scale Division (e_{min})			x (19)		
"S" or "M" (7)				x	
Direction of Loading (15)				x	
Minimum Dead Load				x	
Maximum Capacity				x	
Safe Load Limit				x	
Load Cell Verification Interval (v_{min})				x	
Section Capacity (14)		x	x		

Table 4 Marking Requirement Notes

1. Manufacturer's identification and model designation. (H-44, 1994 G-S.1) *1, 1988]*

2. Serial number [*Nonretroactive as of January 1, 1968]* and prefix [*Nonretroactive as of January 1, 1968]* (H-44, 1994 G-S.1)

3. The nominal capacity and value of the scale division shall be shown together (e.g., 100,000 x 10 lb or 30 x 0.01 lb) adjacent to the weight display when the nominal capacity and value of the scale division are not immediately apparent. Each scale division value or weight unit shall be marked on variable-division value or division-unit scales.[*Nonretroactive as of January 1, 1983]*

4. Required only if different from "d."
[*Nonretroactive as of January 1, 1968]*

5. Required only on class III and III L scales if the range is other than 14 EF to 104 EF (-10 to 40 EC).

6. This value may be stated on load cells in units of 1,000; e.g., n: 10 is 10,000 divisions.[*Nonretroactive 0 as of January 1, 1988]*

7. Denotes compliance for single or multiple load cell applications.

8. An indicating element not permanently attached to a weighing element shall be clearly and permanently marked with the accuracy Class of II, III, III L as appropriate, and the maximum number of scale divisions, n_{\max} , for which the indicator complies with the applicable requirement. Indicating elements that qualify for use in both class III and III L applications may be marked III/III L and shall be marked with the

~~maximum number of scale divisions for which the~~
device complies with the applicable requirements for each accuracy class. [*Nonretroactive as of January*

Notes for Table 4 (continued)

15. Required if the direction of loading the load cell is not obvious. *[Nonretroactive as of January 1, 1988]*

16. Serial number [as of January 1, 1968] and prefix [as of January 1, 1986]. (See G-S.1.) Modules without “intelligence” on a modular system (e.g., printer, keyboard module) are not required to have serial numbers.

17. The accuracy Class of a device shall be marked on the device with the appropriate designation as II, III, III L. *[Nonretroactive as of January 1, 1986]*

18. The nominal capacity shall be conspicuously marked as follows:

(a) on any scale equipped with unit weights or weight ranges;

(b) on any scale with which counterpoise or equal-arm weights are intended to used;

(c) on any automatic-indicating or recording scale so constructed that the capacity of the indicating or recording element, or elements, is not immediately apparent;

(d) on any scale with a nominal capacity less than the sum of the reading elements; and

(e) on the load-receiving element (weigh-bridge) of a vehicle.

[Nonretroactive as of January 1, 1989]

19. *[Nonretroactive as of January 1, 1988]*

(4) Railway Track Scales

A railway track scale shall be marked with the maximum capacity of each section of the load-receiving element of the scale. Such marking shall be accurately and conspicuously presented on or adjacent to the identification or nomenclature plate that is attached to the indicating element of the scale. (H-44, 1994, S.6.4.)

(5) Weighing Elements

On a weighing element not permanently attached to an indicating element, there shall be clearly and permanently marked for the purposes of identification the name, initials, or trademark of the manufacturer, the manufacturer's designation that positively identifies the pattern or design, and the nominal capacity. (H-44, 1994, S.5.2., ABWS Code)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

- (6) Accuracy Class for Scales Manufactured After January 1, 1986

The accuracy class of a device shall be marked on the device with the appropriate designation as II, III, or III L. (H-44, 1994, S.5.1. in part)

- (7) Temperature Limits for Scales Marked with an Accuracy Class for Class III and III L Devices

Unless the temperature range is -10 EC to + 40E (14E F to 104E F), the temperature range shall be marked on the device. (H-44, 1994, S.5.3. ABWS)

h. Installation Requirements

- (1) Protection from Environmental Factors

The indicating elements, the lever system or load cells, the load-receiving element, and test weights shall be adequately protected from environmental factors such as wind, weather, and radio frequency interference that may adversely affect the operation or performance of the system. (H-44, 1994, UR.2.1. ABWS Code in part)

- (2) Foundation, Supports, and Clearance

The foundation and supports of any system shall be such as to provide strength, rigidity, and permanence of all components, and clearance shall be provided around all live parts so that no contact can result before or during operation of the system. On vehicle scales, the clearance between the load-receiving elements and the coping at the bottom edge of the platform shall be greater than at the top edge of the platform. (H-44, 1994, UR.2.2. ABWS Code in part)

- (3) Access to Weighing Elements

Adequate provision shall be made for ready access to the pit of a vehicle or railroad track scale for purposes of inspection and maintenance. Any of these scales without a pit shall be installed with adequate means for inspection and maintenance of the weighing elements. Provisions shall be provided to lock or

securely seal all accesses to the pit. (H-44, 1994, UR.2.5. in part)

(4) Approaches to Vehicle Scales

On the entrance and exit ends of a vehicle scale installed in any one location for a period of 6 months or more, there shall be a straight approach as follows:

- (a) At least the width of the platform.
- (b) The length at least one-half the length of the platform but not required to be more than 12 m (40 ft), and
- (c) Not less than 3 m (10 ft) of any approach adjacent to the platform shall be constructed of concrete or similar durable material to ensure that this portion remains smooth and level and in the same plane as the platform. However, grating of sufficient strength to withstand all loads equal to the concentrated load capacity of the scale may be installed in this portion. Any slope in the remaining portion of the approach shall insure: (1) ease of vehicle access; (2) ease for testing purposes; and (3) drainage away from the scale. (H-44, 1994, UR.2.6.1.)

(5) Hoists

On motor vehicle and railway track scales equipped with means for raising the load-receiving element from the weighing element for vehicle unloading, means shall be provided so that it is readily apparent to the weigher when the load-receiving element is in its designed weighing position. The printer shall not be operable until the load-receiving element is in its designed weighing position. (H-44, 1994, UR.2.8. in part)

i. User Requirements

(1) Balance Condition

The zero-load adjustment of a scale shall be maintained so that, with no load on the load-receiving element and with all load-counterbalancing elements of the scale such as poises, drop weights, or counterbalance weights set to zero, the scale shall indicate or record a zero-balance condition. A scale not equipped to indicate or record a zero-load balance shall be maintained in balance under any no-load condition. (H-44, 1994, UR.4.1.)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

(2) Scale Modifications

The length, nor the width, nor the height of the load-receiving element of a scale shall be increased beyond the manufacturer's design dimension; nor shall the capacity of a scale be increased beyond its design capacity by replacing or modifying the original primary indicating or recording element with one of a higher capacity; nor shall any other modification be made, except when the modification has been approved by a competent engineering authority, preferably that of the engineering department of the manufacturer of the scale and by FGIS. (H-44, 1994, UR.4.3. in part)

(3) Scale Division Selection Requirements for Official Automatic Bulk Weighing Systems

The number of scale divisions of a weighing system shall not be less than 4,000 or greater than 10,000 for a system with a capacity greater than 10,000 pounds and not less than 2,000 or greater than 10,000 for a system with a capacity equal to or less than 10,000 pounds.

(4) Grain Hopper Scales Division Selection Requirement

The minimum number of scale divisions for a Class III Hopper Scale used for weighing grain shall be 2,000. (H-44, 1994, UR.1.2.)

Table 5 Examples of Capacity and Scale Division

System capacity (Pounds)	Value of scale division (Pounds)	Number of scale divisions in system
<u>20 000</u>	<u>2</u>	<u>10 000</u>
20 000	5	4 000
<u>20 000</u>	<u>10</u>	<u>2 000</u>
40 000	5	8 000
<u>40 000</u>	<u>10</u>	<u>4 000</u>
60 000	10	6 000
<u>100 000</u>	<u>10</u>	<u>10 000</u>
100 000	20	5 000
<u>120 000</u>	<u>20</u>	<u>6 000</u>
200 000	20	6 000
<u>200 000</u>	<u>50</u>	<u>4 000</u>

- (5) Scale Division Selection Requirements for Scales Marked With An Accuracy Class Other Than Automatic Bulk Weighing Scales

The accuracy class of a weighing device designated by the manufacturer and shall comply with the parameters shown in Table 6. (H-44, 1994, S.5.2.)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

Table 6 Parameters for Accuracy Classes

Class	Value of the verification scale division (d or e ¹)	Number of scale divisions (n)	
		Minimum	Maximum
SI Units			
II	1 to 50 mg, inclusive	100	100 000
	equal to or greater than 100 mg	5 000	100 000
III	0.1 to 2 g, inclusive	100	10 000
	equal to or greater than 5 g	500	10 000
III L ²	equal to or greater than 2 kg	2 000	10 000
INCH-POUND			
III	0.0002 lb to 0.005 lb, inclusive	100	10 000
	0.005 oz to 0.125 oz, inclusive	100	10 000
	equal to or greater than 0.01 lb	500	10 000
	equal to or greater than 0.25 oz	500	10 000
III L ²	equal to or greater than 5 lb	2 000	10 000
<p>For Class II devices equipped with auxiliary reading means (i.e., a rider, a vernier, or a least significant decimal differentiated by size, shape, or color), the value of the verification scale division "e" is the value of the scale division immediately preceding the auxiliary means.</p> <p>For Class III devices, the value of "e" is specified by the manufacturer as marked on the device; "e" must be less than or equal to "d."</p> <p>The value of a scale division for crane and hopper (other than grain hopper) scales shall be not less than 0.5 lb (0.2 kg). The minimum number of scale divisions shall be not less than 1000.</p> <p>(H-44, 1994, S.6.3.)</p>			

(6) Scale Division Selection Requirements for Scales Not Marked With an Accuracy Class Other Than Automatic Bulk Weighing Scales

Table 7 Applicable to Devices Not Marked with a Class Designation

Scale Type or Design	Maximum Value of d
Grain Hopper Scales Capacity up to and incl. 50 000 lb	10 pounds (but not greater than 0.05 % of capacity)
Capacity over 50 000 lb	20 pounds
Vehicle Scales Capacity up to and including 200 000 lb	20 pounds
Capacity over 200 000 lb	50 pounds
Railway Track Scales With weighbeam	20 pounds
Automatic indicating	100 pounds
Scales with capacities greater than 500 lb except otherwise specified	0.1 % capacity (but not greater than 50 lb)

(7) Scale Division Selection Requirements for Grain Test Scales According To Application

Table 8 Scale Division Selection Requirements for Grain Test Scales According To Application		
Application	Class	Max. Division Size
Scale used to weigh samples equal to or less than 120 g	II (Precision)	.01 g
Scales used to weigh moisture samples of 150 to 300 g	II or III (General)	.1 g
Scales used to weigh samples more than 120 g	II or III (General)	1 g mechanical .5 g electronic

(8) Value of Scale Division (d) and Weight Units

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

The value of the scale division expressed in a unit of weight shall be equal to 1, 2, or 5, or a decimal multiple or submultiple of 1, 2, or 5.

Examples: Scale division may be .01, .02, or .05; .1, .2, or .5; 1, 2, or 5; 10, 20, or 50. (H-44, 1994, S.1.2., S.1.1. in part)

(9) Split or Double Draft Static Weighing

A vehicle or a coupled vehicle combination or a railroad car shall be officially weighed statically on a vehicle or railway track scale only as a single draft. That is, the total weight of such a vehicle or combination shall not be determined by adding together the results obtained by separately and not simultaneously weighing each end of such vehicle or individual elements of such coupled combination.

- (a) The weight of a coupled combination may be determined by uncoupling the various elements (tractor, semi-trailer, trailer), statically weighing each unit separately as a single draft, and adding together the results, or
- (b) The weight of a vehicle or coupled-vehicle combination may be determined by adding together the weights obtained while all individual elements are resting simultaneously on more than one scale platform.
(H-44, 1994, UR.3.3. in part)

(10) Supports

A scale that is portable and that is being used on a counter or table or on the floor shall be so positioned that it is firmly and securely supported. (H-44, 1994, UR.2.1.)

(11) Level Condition

If a scale is equipped with a level-condition indicator, the scale shall be maintained in level. (H-44, 1994, UR.4.2.)

(12) Railway Track Scales; Alignment of Dead and Weigh Rails

Dead rails should be provided for all scales where designed capacity does not correspond with the greatest combined load likely to run over scale rails. Weigh rails should be on the offset line and the dead rails should be straight unless a large portion of the cars is to be weighed.

(13) Standing of Equipment and Keeping Scales Under Load

Equipment shall not be allowed to stand on the platform of a vehicle or railway track scale except when being weighed and, in the case of hopper scales, grain shall not normally be retained on the weighing element for periods longer than a normal weighing cycle.

(14) Altering Poises and Counterpoise Weights

After a poise or counterpoise weight has been sealed, no material shall be added or removed without the approval of FGIS and an official test shall be conducted to recertify the scale.

(15) Hopper Scale Venting

All weighing systems shall be vented so that any internal or external pressure will not affect the accuracy or operation of the system. (H-44, 1994, S.4.4. ABWS Code)

(16) Minimum Test Weight Load for Automatic Bulk Weighing Scales

The minimum amount of certified test weight required for testing shall be 10% of scale capacity. (An increasing-load test using bulk material shall be conducted in increments not greater than the total value of the official test weights; the test shall be conducted to the official capacity of the weighing system.) (H-44, 1994, N.1. ABWS Code in part)

(17) Minimum Test Weight Load for Railway Track Scales

In the test of a railway track scale, the test weight load shall be not less than 80,000 pounds.

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

- (18) Minimum Test Weights and Test Loads for Scales Other Than Automatic Bulk Weighing and Railway Track Scales

The minimum test weights and test loads for in-service tests are shown below.

Table 9 Minimum Test Weights and Test Loads			
Device capacity (pounds)	Minimums (in terms of device capacity)		Recommended** (where practicable)
	Test weights (greater of)	Test loads*	
0 to 100	105%		
101 to 1 000	50% or 100 lb	105%	
1 001 to 40 000	25% or 500 lbs	50%	Test weights to dial face capacity, 1000 d or test load to used capacity, if greater than minimums specified
40 000 +	12.5% or 10 000 lb	25%	
<p>*The term "test load" means the sum of the combination of field standard test weights and any other applied load used in the conduct of a test using substitution or build-up test methods.</p> <p>(H-44, 1994, N.3. in part)</p>			

(19) Assistance in Testing

If the design construction, or location of any scale is such as to require a testing procedure involving special equipment, accessories, or an abnormal amount of labor, the equipment, accessories, and labor shall be supplied by the owner or operator of the device. Test weights calibrated to service specifications shall be supplied by the scale owner or operator. (H-44, 1994, G-UR.4.4. in part)

(20) Minimum Loading Requirement for an Automatic Bulk Weighing Scale

A system shall not be used to weigh drafts less than 40 percent of the weighing capacity of the system except for a final partial draft. (H-44, 1994, UR.3.1. ABWS Code in part)

(21) Minimum Load for a Vehicle Scale

A vehicle scale shall not be used for weighing net loads smaller than 50 d. (H-44, 1994, UR.3.7.)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

(22) Maximum Load

A scale shall not be used to weigh a load more than the nominal capacity of the scale. (H-44, 1994, U.R.3.2.)

j. Railway Track Scales; Additional Requirement Guidelines

(1) Rated Sectional Capacity

Table 10 Rated Capacity of Full Load Cell Scale	
Sectional capacity (tons)	Each load-cell rated capacity (pounds)
Track scale: 85	100 000
180	200 000

The rated sectional capacity of a full load cell scale should be one of those shown in Table 11 and shall employ load cells in capacities as shown.

The rated sectional capacity should be in no case exceed the actual sectional capacity. (Association of American Railroads, Engineering Division, Scale Handbook (AAR Handbook, 1996, 2.2.2.)

(2) Nose-Iron Guides

The guides for all noise-irons should be such that when one is moved for the purpose of adjustment, the pivot will be held parallel to its original position. The guide and ways of each cast iron lever should be machined. (AAR Handbook, 1996, 2.5.2)

(3) Leveling Lugs

In scales of the straight lever type, each lever should be provided with leveling lugs for longitudinal alignment. In scales of the torsion lever type, leveling lugs should be provided on the pipe or torsion member for transverse alignment and on the extension arm for longitudinal alignment. Each pair of lugs should be spaced 11 inches apart. The leveling surfaces of each pair of lugs should be finished to a common plane, which should be parallel to the plane through the knife-edges of the end pivots. (AAR Handbook, 1996, 2.5.3)

(4) Marking of Levers

Figures denoting the ratio of each lever should be cast or otherwise permanently marked on the lever. On a weighing element not permanently attached to an indicating element, there should be clearly and permanently marked for the purposes of identification, the name, initial, or the trade mark of the manufacturer's designation that positively identifies the pattern, or design, the nominal capacity, and the sectional capacity. (AAR Handbook, 1996, 2.5.5)

(5) Pivots and Bearings; Material

The material to be used for pivots and bearings should be alloy steel (SAE 52100), or a steel which will give equivalent performance, hardened to Rockwell C scale not less than 58 or more than 62. (AAR Handbook, 1996, 2.6.1)

(6) Design and Manufacture

Pivots should be so formed that the included angle of the sides forming the knife-edge will not exceed 90° and that the offset of the knife-edge from the center line of the pivot will not exceed 10 percent of the width of the pivot. (AAR Handbook, 1996, 2.6.2)

(7) Machined-in Pivots, When Required

For scales of greater sectional capacity than 50 tons, main lever pivots should be machine finished and fitted into machined ways. (AAR Handbook, 1996, 2.6.3 (b))

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

(8) Continuous Contact Required

Pivots should be mounted so that continuous contact of the knife-edges with their respective bearings for the full length of the parts designed to be in contact will be obtained; in loop bearings the knife-edges should project slightly beyond the bearings in the loops. (AAR Handbook, 1996, 2.6.3 (c))

(9) Position

In any lever the pivots should be mounted so that:

- (a) Each knife-edge will be maintained in a horizontal plane under any load within the capacity of the scale;
- (b) A plane bisecting the angle of a knife-edge of any lever will be perpendicular to the plane through the knife-edges of the end pivots;
- (c) The actual distance between the end knife- edges of any lever will not differ from the nominal distance by more than 1/64 inch per foot; and
- (d) The knife-edges in any lever will be parallel. (AAR Handbook, 1996, 2.6.4 (a)-(d))

(10) Support for Projecting Pivots

The reinforcement on the levers to support projecting pivots should be tapered off to prevent accumulation of dirt next to the pivots and to provide proper clearance. (AAR Handbook, 1996, 2.6.5)

(11) Design of Bearings

Bearing steels and the parts supporting or containing them should be so applied to the mechanism that permissible movement of the platform will not displace the line of contact between any bearing and the opposing pivot. (AAR Handbook, 1996, 2.6.7)

(12) Nose-Iron Design

Nose-irons should be constructed so that:

- (a) They will be positioned by means of adjusting screws of standard size and thread;
- (b) They will be retained in position by means of screws or bolts of standard size and thread; The surfaces of nose-irons intended to be in slidable contact with the levers will be machined true, so as to securely fit in or on the levers; and
- (c) When adjustments are made, the knife-edge will be held parallel to its normal position. (AAR Handbook, 1996, 2.7.1 (a)-(d))

(13) Screws and Bolts

Adjusting and retaining screws and bolts should be made of a corrosion-resistant material. (AAR Handbook, 1996, 2.7.2)

(14) Retaining Device

A device for retaining each nose-iron in position should be provided and should be designed and constructed so that it will:

- (a) Be independent of the means provided for adjustments;
- (b) Not cause indentations in the lever;
- (c) Not cause tension in the remaining bolts when loads are applied to the scale; and
- (d) Cause the nose-iron to remain in position when the retaining device is released. (AAR Handbook, 1996, 2.7.3 (a)-(d))

(15) Loops and Connections; Material

The requirements for material and hardness of bearing surfaces in loop connections should be the same as those herein prescribed for pivots and bearings material. (AAR Handbook, 1996, 2.9.1 in part)

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

(16) Weighbeam Support

The weighbeam fulcrum stand and trig loop stand should be supported on a metal shelf mounted on metal pillars or material equivalent in strength and durability. The shelf should be sufficiently rigid that, within the capacity of the scale, deflection cannot occur to such an extent as will affect the weighing performance. (AAR Handbook 1991, 2.4.14)

(17) Weighbridge Girders

Weighbridge girders should be designed so that the joints over the centers of bearing will admit vertical flexure without deranging the sections. On short axle weighbridges no tipping of the weighbridges will be allowed. (AAR Handbook, 1996, 2.14.1)

(18) Weighbridge Bearings

The surfaces of weighbridge bearings intended to make contact with the bridge girders should be finished so that, when in position, all the bearing surfaces will be within 1/32 inch of the same horizontal plane and parallel to it. To secure proper alignment of parts, the diameters of the bolt holes in the weighbridge bearings and in the girders shall exceed the diameter of the bolts fastening the bearings to the girders by 1/2 inch. (AAR Handbook, 1996, 2.14.2)

(19) Stresses

To allow for impact and normal pit conditions, all steel design stress in scale weighbridges should be limited to 10,000 psi, and maximum deflection in main weighbridge beams or girders should not exceed 1/1200 of the span between sections. (AAR Handbook, 1996, 2.14.3 (b))

(20) Weigh Rails - Length and Weight

The weight and section of weigh rails should be as large as is consistent with surrounding yard track conditions, but no less than 115 pounds per yard. Rails should be one piece full length of scale. (AAR Handbook, 1996, 2.14.10 (a))

(21) Clearance Along Weigh Rails

The clearance between weigh rails or their pedestals and the rigid deck should be less than 1 ½ inches unless other adequate provision for clearance is made, and the openings should be protected from weather and foreign material. (AAR Handbook, 1996, 2.14.10 (c))

(22) Approach Rails

The approach rails should be in the same plane and alignment as the weigh rails and should be properly anchored to prevent creeping of approach rails to maintain the gap between the weighrails and the approach rails. Expansion rails are desirable whenever temperature extremes or mechanical displacement due to repeated loadings, as at humps, are anticipated. The gap should not be less than **C** inch nor exceed **E** inch unless special means are utilized to reduce impact from wheel loads passing from the approach rails to the weighrails. (AAR Handbook, 1996, 2.16.1)

(23) Miter Joints

For motion weighing scales, mitered joints should be provided. (AAR Handbook, 1996, 2.16.2)

(24) Clearance

The clearance between the bottom of any fixed beams, or deck supports, and the girder forming the weighbridge should not be less than 2 inches. (AAR Handbook, 1996, 2.18.3)

(25) Location

Scales should be so located that an adequate foundation and at least 75 feet of tangent track at each approach to the weigh rails can be provided. (AAR Handbook, 1996, 2.21.1 (a))

WEIGHING HANDBOOK
CHAPTER 3
3.3 CLASSIFICATION OF REQUIREMENTS
9/20/96

(26) Approach Walls Static Scales

Approach walls or piers of concrete should be built to extend at least 25 feet from the pit face of the end walls and back under the track to preserve line and surface of tracks. They may be built of a solid mass of concrete or may consist of parallel walls or piers; however, the latter construction should have a single footing supporting both walls. Where necessary to obtain safe bearing capacity, the approach walls should extend to the same depth as the pit walls. (AAR Handbook, 1996, 2.22.6 (a))

(27) Footings or Piers for Load Cells

Concrete footings or piers supporting load-cell base plates should not be less than 18 inches thick. Their tops shall be above the floor a sufficient distance to prevent the accumulation of water around or under the base plates. (AAR Handbook, 1996, 2.22.10 (b))

(28) Footings or Piers for Lever Stands

Concrete footings or piers supporting the lever stands should be not less than 18 inches thick. Their tops shall be above the floor a sufficient distance to prevent the accumulation of water under the base of the stand, and should be finished to an exact level and elevation to receive the lever stands directly without the use of shims or grouting where possible. If the scale is of a type having main levers or parts of the bearing assemblies that hang below the bases of the main lever stands, the piers should be provided with recesses of a size to give clearance of not less than 1.5 inches and should be formed so as to prevent accumulation of foreign matter. (AAR Handbook, 1996, 2.22.10 (a))

(29) Anchor Bolts

Anchor bolts for lever stands (minimum 2 each) or load cell base plates (minimum 4 each) should be embedded in the concrete foundation a minimum of ten inches and they should be provided with hooks, plates, or other

projection embedded at least eight inches below the finished concrete bearing surface. (AAR Handbook, 1996, 2.22.12)

(30) Bearing Pressures Under Foundations

The bearing areas of the foundation footings should be such that the pressure under the footings will not exceed:

- (a) For fine sand and clay -- 4,000 lb. per sq. ft.
- (b) For coarse sand and gravel or hard clay -- 6,000 lb. per sq. ft.
- (c) For boulders or solid rock--20,000 lb. per sq. ft. If the soil does not have a bearing capacity of at least 4,000 pounds per sq. ft. and its bearing capacity cannot be increased by drainage, by stabilization, or by other means, pile foundations should be provided. Careful soil exploration, including bores, is always desirable. (AAR Handbook, 1996, 2.22.19)